STEReO 1.0 Overview

March 10th, 2022

Problem

- Emergency response operations aren't easy:
  - Conducted under adverse conditions
  - Involve numerous organizations
  - Limited communication and infrastructure
  - Manual coordination to deconflict/use airspace
  - Challenges with timeliness of information

The result? Safe procedures with few technological advances

Solution

- Use innovative communication approaches to enable new traffic management and autonomous vehicle capabilities, providing a data-rich common operating picture

Task breakdown

- Underlying question

  To what extent can a UTM-like ecosystem:
  (1) Build trust,
  (2) Scale aircraft operations,
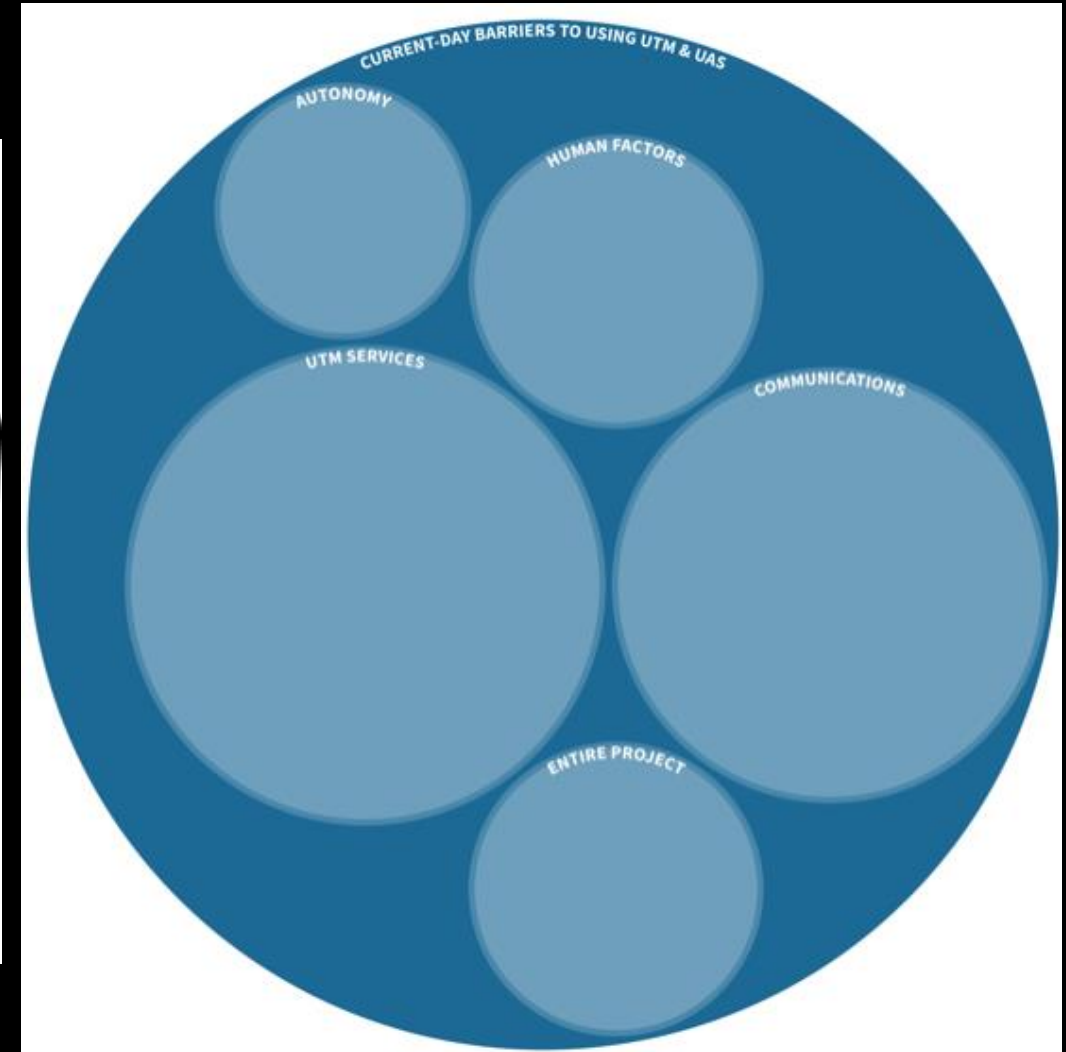 (3) Provide operational resiliency?

- Apply NASA's expertise in four areas:
  - Communications/connectivity
  - UTM services
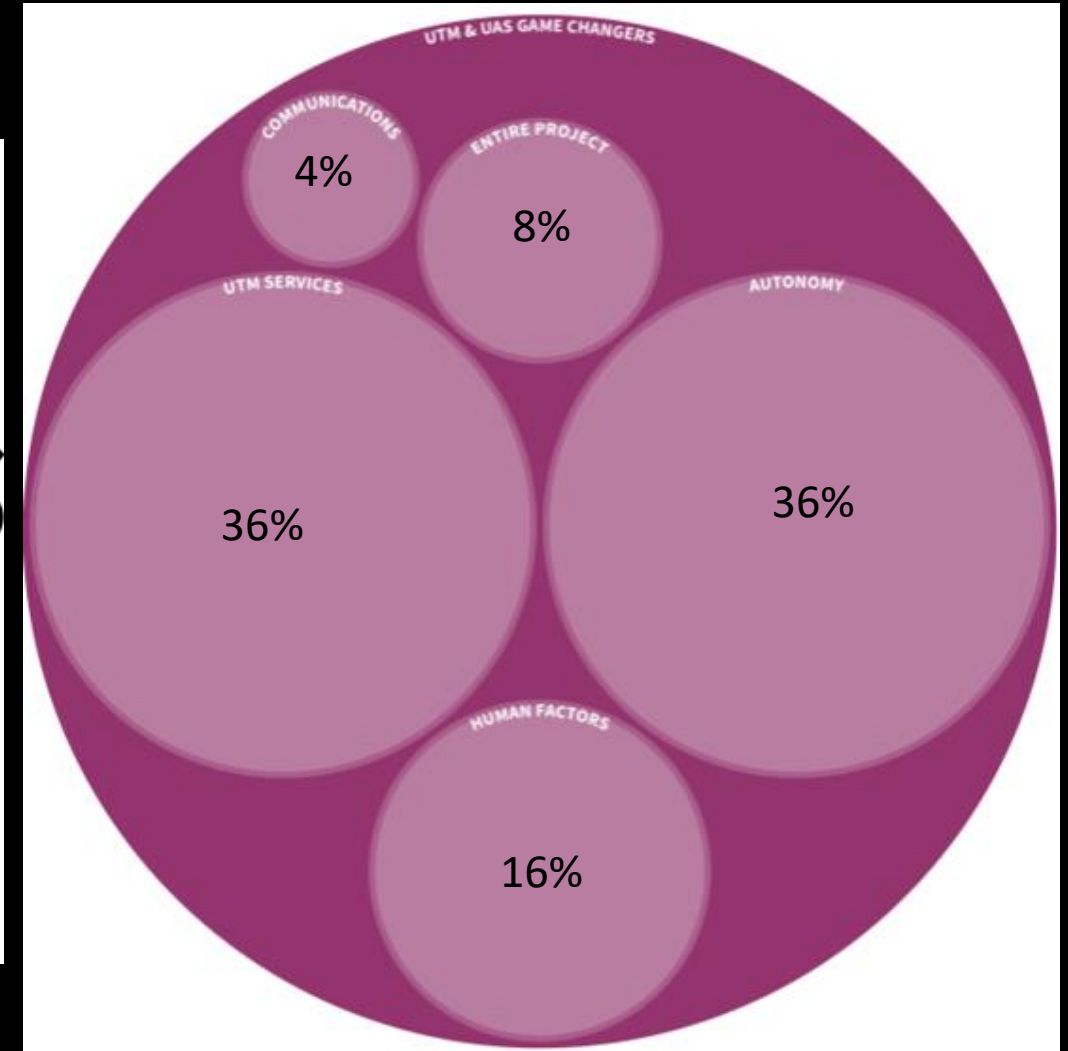 - Vehicle autonomy
  - Human factors

- Leverage partner resources and skillsets:
  - Domain expertise & tools

02/2020 Workshop Findings – Current-day barriers
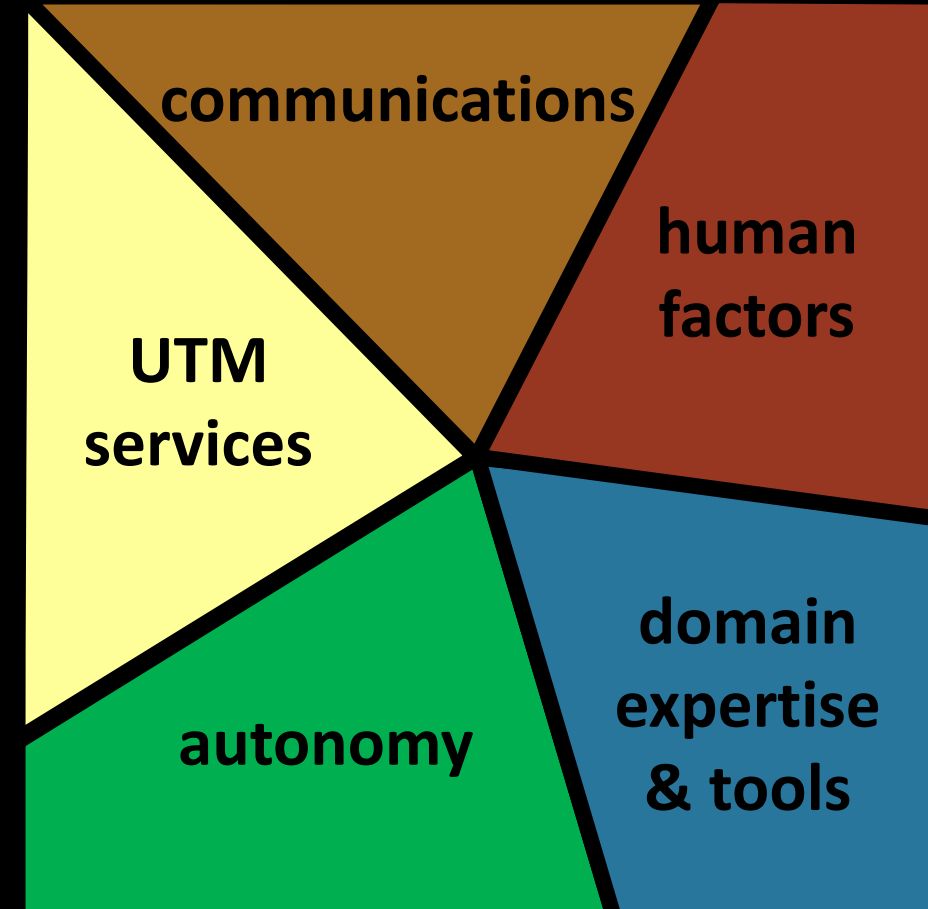
02/2020 Workshop Findings – What-if game changers

Autonomy – Objectives

- Develop a testing environment to study interactions between uncrewed and crewed aircraft
  - Representative of the real-world emergency response operations
  - Matures testing capabilities that can be useful to other ARMD projects
  - Applies to HWITL & simulations
- Integrate software/hardware capabilities onto an sUAS platform that can enable DAA and BVLOS operations
  - V2V, LiDAR, EO/IR, S2D+ICAROUS, PDF, path planning
- Gather end-user feedback on autonomous functions that add value

Communications – Objectives

- Develop a product that uses the 81GHz band for V2V communication
  - Model comms behaviors to understand limits and options
  - Modify existing COTS hardware for use with 81GHz
- Harden comm links for "BYO internet" needed for portable UTM-in-a-box
  - Redundant links
  - Resilient to challenges within rugged environments
  - Bandwidth vs. cost vs. portability considerations

Human Factors – Challenges

- What are the key challenges that specific individuals face today when using current-day methods?
  - How can we position STEReO capabilities to address those challenges?
- Who is/are the end-user(s) that will benefit most from a modernized emergency response operation?
  - How can we design interactions/demonstrations that highlight such benefits?

Objectives

- Build and maintain clear understanding of end-user perspectives
  - Helps the STEReO team make decisions that benefit emergency responders
  - Perform cross-cutting "market research" to connect the dots between STEReO's technical areas and real-world decisions/tasks/actors/teams

UTM Services – Objectives

- Extend USS capabilities to the unique needs of emergency response operations
  - Air and ground assets are both relevant
  - Persistent infrastructure/connectivity should not be assumed
  - Digital data exchanges that enhance operator awareness

- How to make a portable USS that can function in comms-denied environments?
  - Readiness for low-bandwidth and/or unstable links
  - Small form-factor, simplified deployment
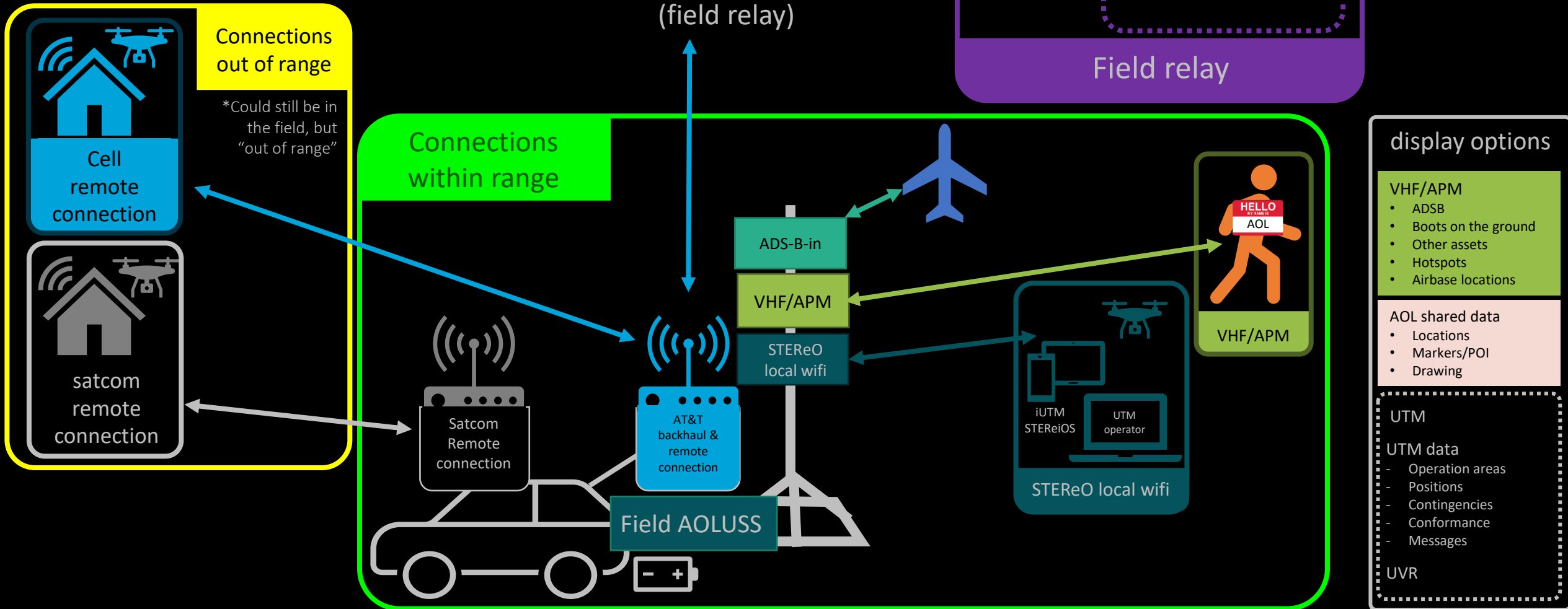
Domain Expertise & Tools – Objectives

- Understand the end-user's problems
  - What task are the users struggling to perform?
  - Are any other parties involved?
  - What solutions are they hoping for?

- Establish partnerships with key stakeholders to enable the synergies between highly-specialized operations and STEReO skillsets
  - Emergency responders
  - Tech & telecom
  - Public utilities
  - OGAs
- Identify overlaps/gaps with end-user's existing products/workflows
  - Data displays
  - Data management

Outcomes

STEReO so far...

- Established relationships with the wildland firefighting community
- Prioritized partners' challenges over researchers' interests
- Observations from the field added clarity to human-system integration issues

The result? specific needs (lower-hanging fruit) become a key focus for FY22

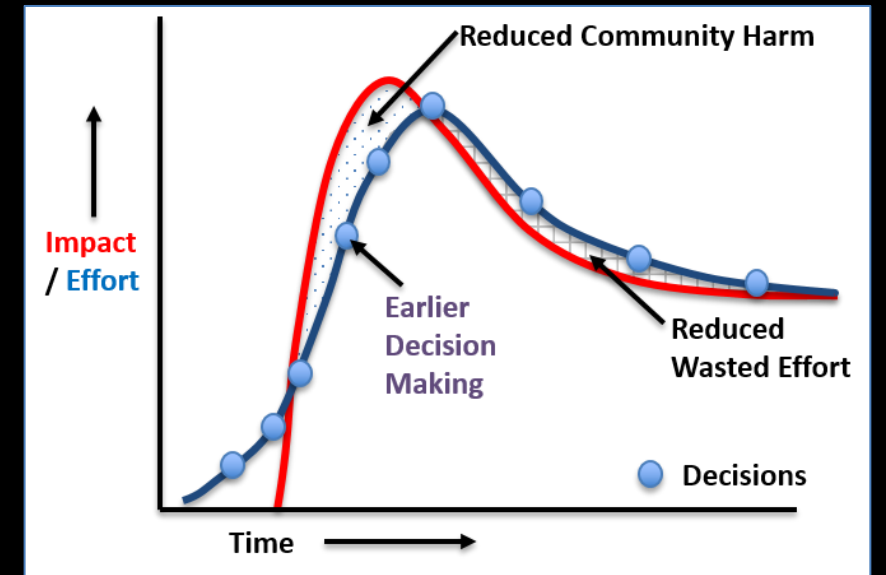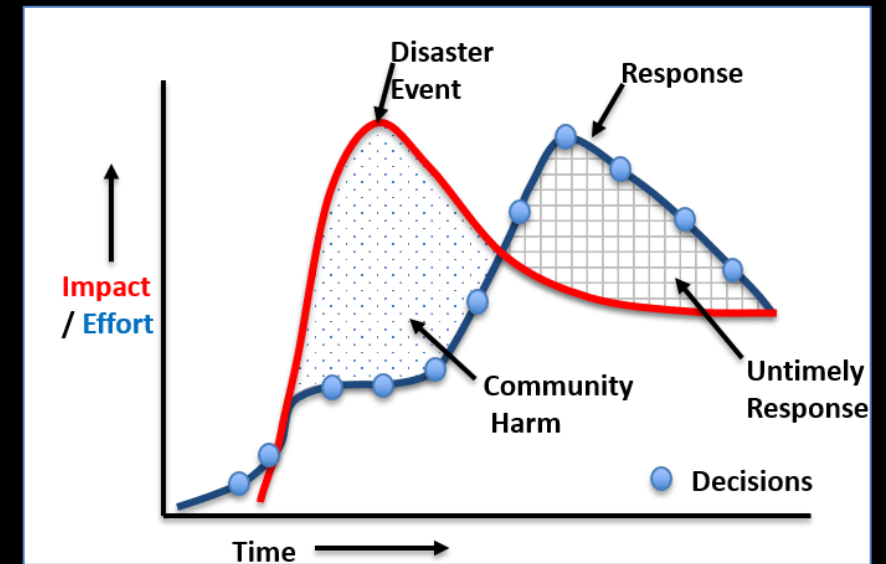# questions?

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Backup

Approach

theoretical emergency response (current-day)

- assume this ------------------------------------->

- work towards this -------------------------->

Underlying question

To what extent can a UTM ecosystem:
(1) build trust,
(2) scale aircraft operations,
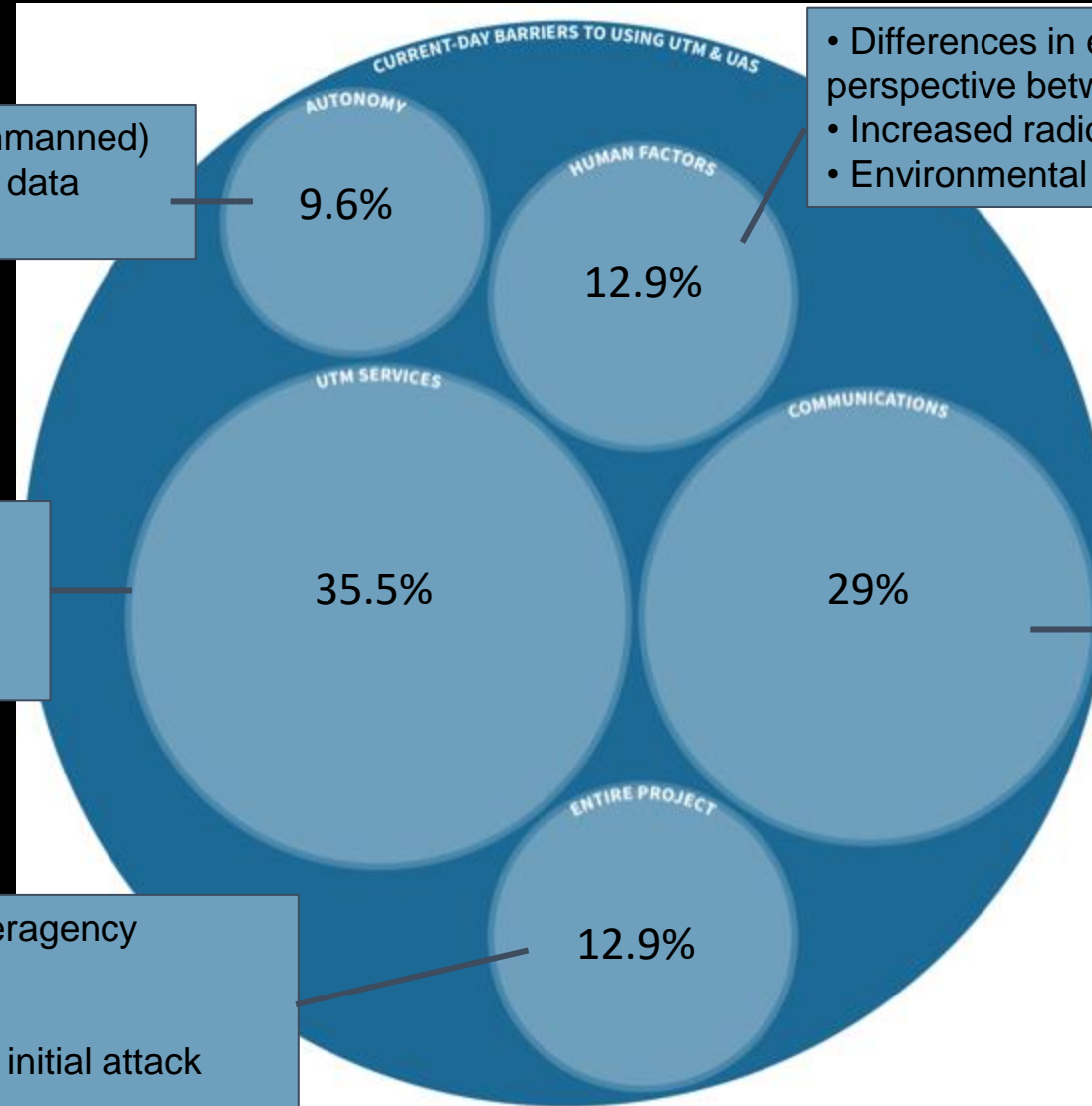(3) provide operational resiliency?

theoretical emergency response (STEReO)

02/2020 Workshop Findings – Current-day barriers

CURRENT-DAY BARRIERS TO USING UTM & UAS

- **AUTONOMY** — 9.6%
- **HUMAN FACTORS** — 12.9%
- **UTM SERVICES** — 35.5%
- **COMMUNICATIONS** — 29%
- **ENTIRE PROJECT** — 12.9%

AUTONOMY (9.6%)
- Traffic management (manned and unmanned)
- Connectivity, transfer, and storage of data
- Scalability

HUMAN FACTORS (12.9%)
- Differences in education, training, terminology, and perspective between manned vs unmanned pilots
- Increased radio traffic when sharing airspace
- Environmental conditions

UTM SERVICES (35.5%)
- Connectivity / communication
- Data processing, disseminating, filtering
- Data security and usability

COMMUNICATIONS (29%)
- No infrastructure, centralized authority / overseer of communications, and guarantee of communications
- Time to set up
- Imperfect communications and knowledge
- Limited access and usability of data and equipment

ENTIRE PROJECT (12.9%)
- Lack of connectivity and interagency coordination
- Institutional mindsets
- PII and slow deployment for initial attack
- Information overload

02/2020 Workshop Findings – What-if game changers

STEReO — Scalable Traffic Management for Emergency Response Operations

NASA

UTM & UAS GAME CHANGERS

COMMUNICATIONS — 4%
ENTIRE PROJECT — 8%
UTM SERVICES — 36%
AUTONOMY — 36%
HUMAN FACTORS — 16%

- Greater access to airspace (can operate in non-TFR)
- Unman all the risky operations--aerial ignition, controlled burns, reconnaissance can be done quicker and safer
- Night operations
- Timelier response

- Post-incident damage assessment
- Providing intel in no-visibility situations
- Logistics support, carrying cargo, transporting resources
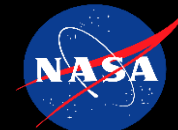- Identify safe routes on the ground
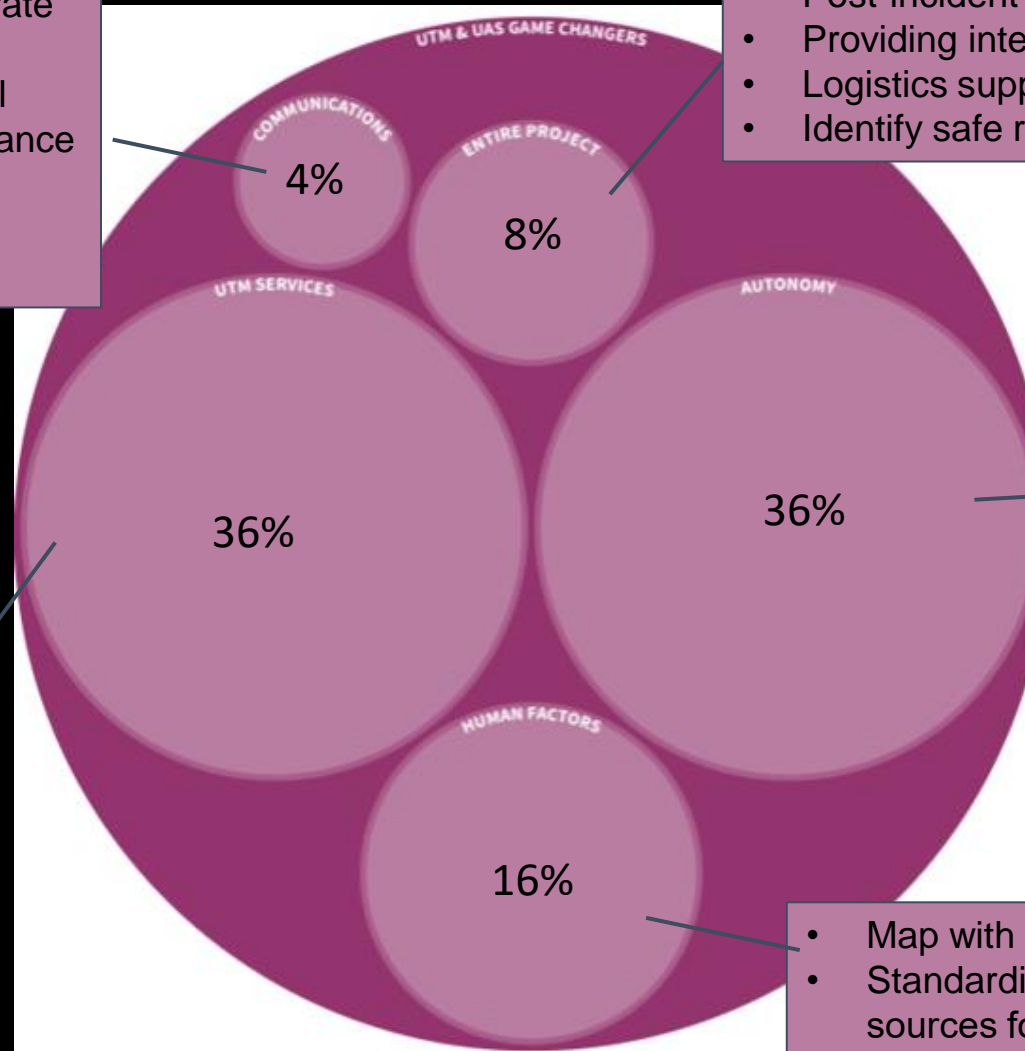
- Safe integration of UAS in the FTA
- 'Firefighter' tracking and accountability
- Autonomous detection and response
- Automated access to airspace
- One-to-many flying options

- Camera mounted to air boss aircraft with video coverage with a pin drop to see immediate threats, escape routes, self-generated intel
- Pin location on interactive map to share or save and leave a note to share with anyone who has access
- Share geofence information to identify unfriendly drones
- internal/external crowdsourcing
- UAV as a tool to fill in blanks for info about topography, weather, fire perimeter, resources, etc.

- Map with real time information
- Standardization of sources or translation of different sources for the user's tool
- UAS to verify, GPS locations, dedicated network

IAA research questions

- What happens if a BVLOS operation needs to abort its mission early, and divert to an alternate landing site?
  - How to enable a safe landing at a location separated from the pilot?
  - How will the contingency plan/maneuver be clearly communicated to other aircraft?
- Can onboard equipment give an sUAS vehicle real-time awareness of a previously unknown environment in order to enable a safe BVLOS operation?
  - How can sensor data become a part of the vehicle's control loop?
  - How can traffic awareness be maintained in order to avoid incursions?
- …How to ensure these capabilities complement a highly-automated traffic management system?